MARCH 1968

orthotics and prosthetics

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the Journal of the Orthotic and Prosthetic Profession

Volume 22 Number 1 March 1968

second class postage paid at Washington, D.C., USA

Contents

Audrey J. Calomino, *Editor*

Orthotics and Prosthetics: The Orthopedic and Prosthetic Appliance Journal is issued in March, June, September and December. Subscription price, payable in advance, is five dollars a year in the Western Hemisphere, rate elsewhere is six dollars a year. Publication does not constitute official endorsement of opinions presented in articles. The Journal is the official organ of its publisher, The American Orthotic and Prosthetic Association. All correspondence should be addressed to: Editor: Orthotics and Prosthetics, 919 18th St., N.W., Washington, D.C. 2006. Telephone, Area Code 202, 296-4160.

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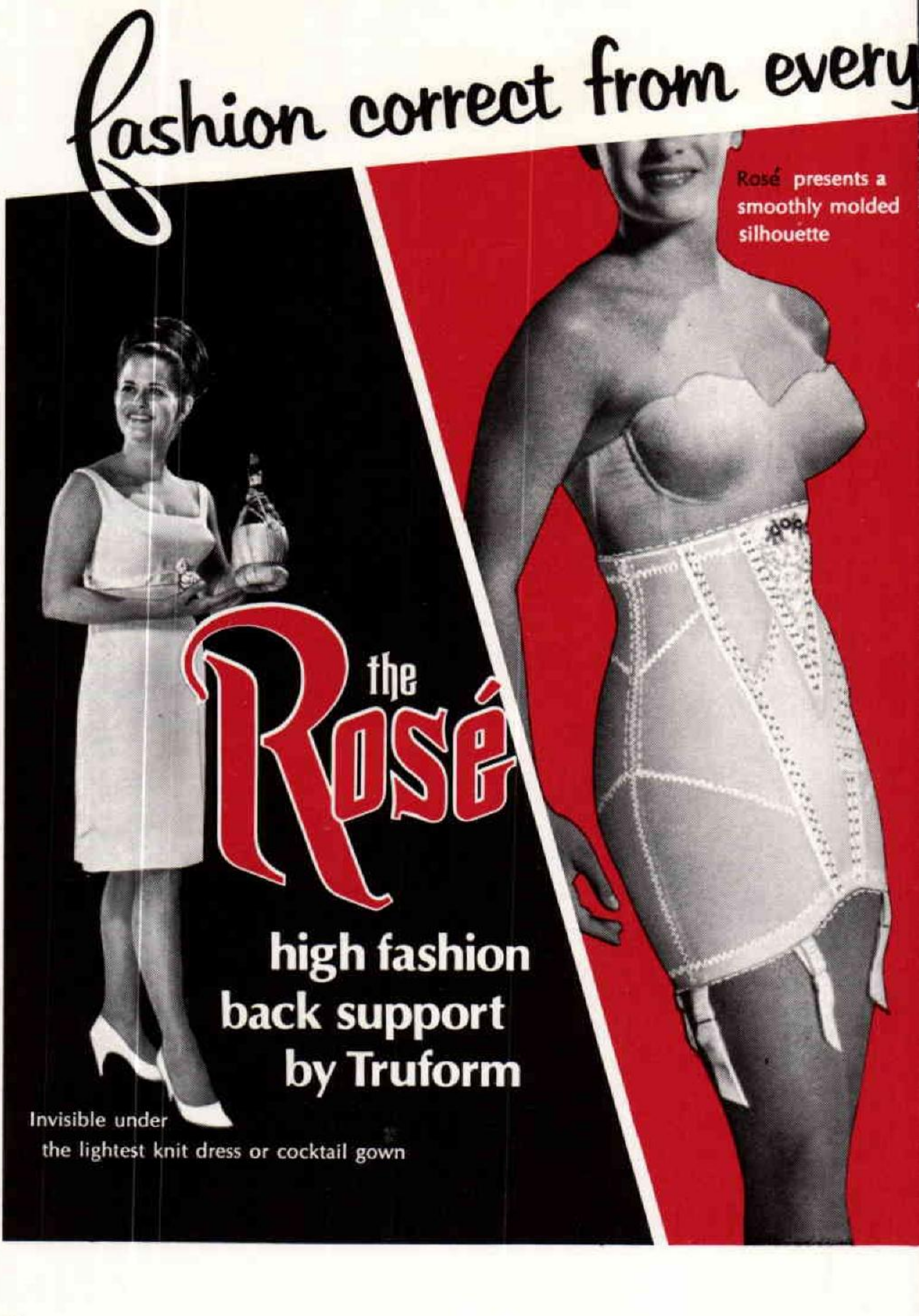
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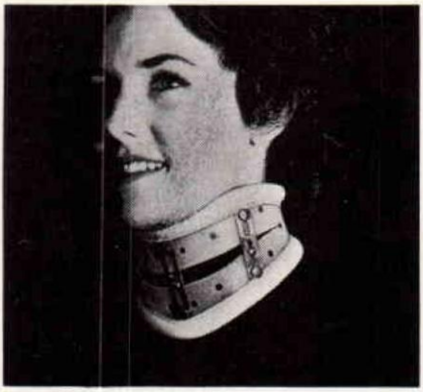

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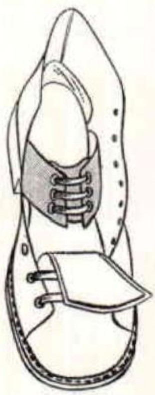

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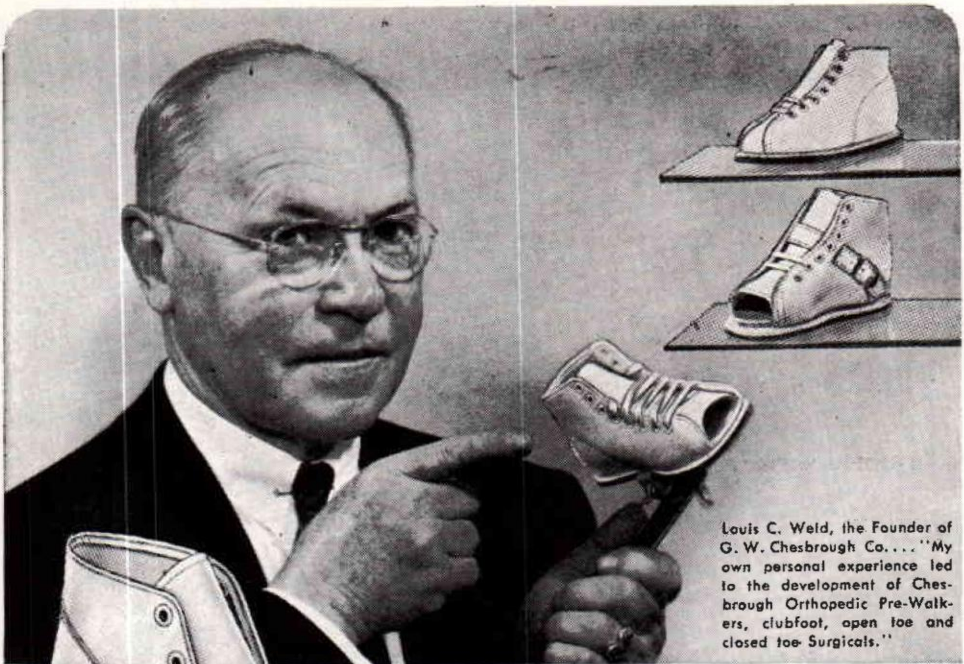

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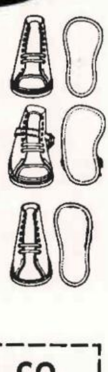

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Dynamic Heel Cord Stretching Orthesis

JAMES E. SWEIGART, C.O.
Superintendent Orthotic and Prosthetic Facility
State Hospital for Crippled Children
Elizabethtown, Pennsylvania

The need for a brace to stretch a tight, stubborn heel cord was recognized by J. A. Bailey II, M.D., while he was Chief Orthopedic Resident at the State Hospital for Crippled Children, Elizabethtown, Pennsylvania. Since Dr. Bailey had obtained good results with a plaster cast, he inquired if it would be possible to develop a brace to accomplish the same result.

The plaster cast used was loosely fitted over the forefoot. A patten was incorporated into the cast, the heel was cut from the cast allowing the heel to settle through the hole and the heel cord to stretch. **Figure 1** shows the completed brace.

The measurements of the metal used in the description of this brace are appropriate for a child approximately 10-11 years old, and weighing about 90-100 pounds.

Actual construction is as follows:

The distance is measured from the sole of the foot to a point distal to the head of the fibula deducting about 15% from the measurement (to make certain the peroneal nerve is not involved), adding two and a half inches to the above measurement to allow for the heel cord to stretch on weight bearing. This gives the overall length for the medial and lateral uprights. These are made of 5/32″ x 5/8″ #304 stainless steel. A 16-gauge steel sole plate, that is slightly curved to facilitate roll-off, is welded to the medial and lateral uprights. Sole leather is riveted to the sole plate which, in turn, is covered with rubber to give a more positive walking surface.

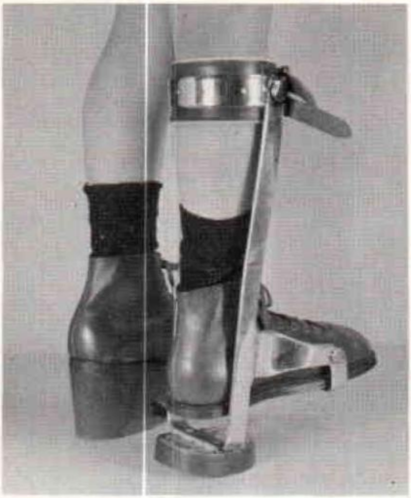 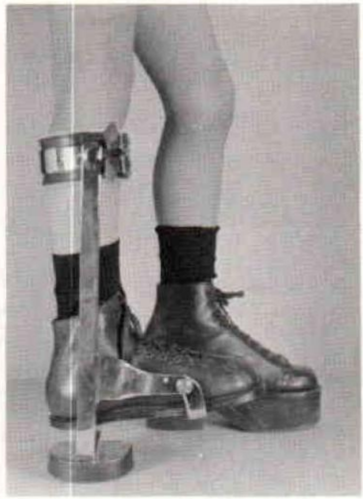

FIGURE 1 and 1A—Complete brace.

To the medial and lateral uprights the anterior supports, which are cut from ⅛″ x 1¼″ #304 stainless steel, are welded. These must extend far enough anteriorly to attach to the anterior stirrup. The stirrup is cut from ⅛″ x 1¼″ #304 stainless steel. This is then butt-welded to a piece of ⅛″ x 1¼″ #304 stainless steel which is shaped to fit on the outside of the sole of the shoe to retain the shape of the shoe. The placement of the pivoting joint coincides with the metatarsophalangeal joint **(Figure 2).**

Surgical shoes are the easiest to attach to the stirrup, since they facilitate insertion of the distal rivet which holds the shoe to the foot plate. The type of shoe is determined by the pathology of the foot; some feet require a normal last shoe; others, outflares or straight lasts.

The pivoting joint is a shouldered rivet. This has worked well. When the patient bears weight, the foot pivots and the patient's weight stretches the heel cord. When the patient lifts his foot to take a step, the upright contacts a stop set at 90° **(Figure 3),** so that the foot cannot be plantarflexed. When the patient is weight-bearing on the foot opposite the brace, this stop causes the brace to lift with the foot as that foot is raised. The stop is simply a projection on the stirrup which contacts an 8 x 32 cap screw set in the anterior support bracket.

An adjustable stop was tried **(Figure 4),** but it did not justify the effort, so it was discarded in favor of the fixed stop set at 90°.

The calf is measured at the fullest part and the band is made of stainless steel with a leather calf cuff. Buckles and straps or Velcro may be used as fasteners. Anterior and posterior bands were tried; the removable posterior band seems to offer the better result. It supports

FIGURE 2—Sole plate and stirrup.

the calf posteriorly where the pressure is greatest and also facilitates applying the brace when the heel cord is extremely tight. The calf band is attached by a square shank rivet which fits into a slot in the medial and lateral bar **(Figure 5).** This also insures a better fit of the calf band and cuff as the patient moves up and down in the brace.

At this time the placement of the fulcrum is at the metatarsophalangeal joint. Whether this is the optimum point for its placement remains to be proven. One of the local universities is planning to do a study of this feature.

Due to the fact that the brace is of the patten type, the shoe on the other foot must have a build-up to balance the patient for proper gait.

Patients with bilateral involvement wear the brace alternately on each foot for a given period of time, which requires the shoe on the other foot to have an elevation on the sole. There are several ways of doing this that are feasible. If straight-last shoes are used bilaterally, they are worn alternately; if regular-type shoes are used, three shoes are required, the one on the brace a straight-last shoe and a pair of normal-last with elevations to be worn alternately on the foot opposite the brace. If outflare or normal-last shoes are indicated in bilaterally involved patients, two braces are needed. One brace is used at a time because it is almost impossible to walk on a pair of patten-ending appliances without crutches.

I have avoided mentioning any claims or conclusions, since we are in the process of compiling data for later publication.

At this time no effort has been made to engineer any of the weight out of the orthesis. In fact, sturdy

FIGURE 3—90° stop.

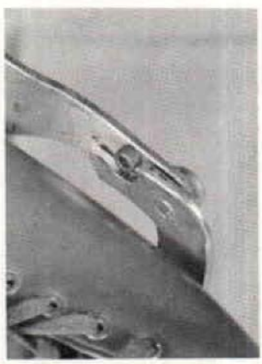

FIGURE 4—Adjustable stop.

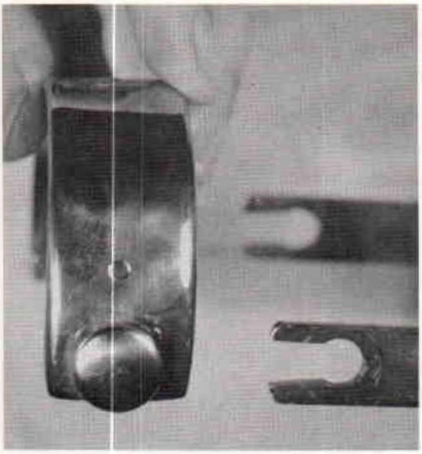

FIGURE 5—Removable calf band.

construction without consideration of weight was deliberate to eliminate mechanical breakdown.

For taking X-rays, the shoe is removed from the uprights and inserted in a jig **(Figure 6).** This eliminates the anterior support bar's obscuring the midtarsal region when a lateral X-ray is taken. The jig consists of a board 6″ x 12″ in size to which is attached a pair of anterior uprights approximately 3″ high. The shoe is attached to these uprights which serve as a fulcrum.

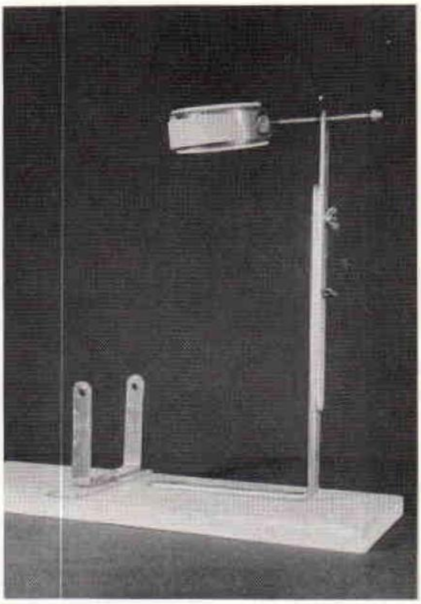

FIGURE 6—X-ray jig.

There is a posterior vertically adjustable bar and a calf band, adjustable posteriorly and anteriorly, that are used to align the leg properly. The X-ray is then taken obtaining an unobstructed view of the midtarsal region to help the orthopedic surgeon and the radiologist in reading the X-rays.

ACKNOWLEDGEMENTS

The author wishes to thank Dr. Bailey for pointing out the need for this type of appliance; Albert Drace, Orthotist; Francis S. Gilmore, X-ray Technician and Photographer; and all other hospital personnel who were involved in this project.

Dr. Bailey is now affiliated with the Hospital for Joint Diseases, New York, New York.

Hydraulics for Prosthetic Devices

DAVID W. LEWIS, PH.D.
University of Virginia
Charlottesville, Virginia

One might commence with a paper of this title by reeling off a list of desirable attributes normally associated with the application of hydraulics. Diversionary logic such as a reminder that you stake your life on the side of hydraulics (i.e. brakes on your automobile) or to envisage for you the power associated with hydraulics (i.e. the garage lift that seemingly effortlessly raises your auto on a single steel finger) are arguments that may be irrelevant for the application that you contemplate. Obviously if one wishes to decide which is the optimum design between two prosthetic devices he must have considerably more information than just the engineering performance specifications. One must know the total demand, today, for a device—and prognosticate the demand for tomorrow. One must separate need from desire—must consider these as a function of cost—must relate these to the overall economy of a State or the Nation. These facets should be the topic for consideration sometime. But for now let us consider the application of hydraulics to a couple of "breadboard" models.

Fig. 1 illustrates a body-powered unit that employs hydraulic fluid for transmitting a simple figure eight harness to a Dorrance 5X terminal device. It is the hydraulic equivalent to the conventional Bowden cable system. The master cylinder I.D. (inside diameter) is 9/16″; the terminal device actuating cylinder I.D. is 7/16″. The volumetric capacity of a cylinder is proportional to the square of its diameter. For the unit of **Fig. 1,** the ratio of the displacements of the master cylinder to the terminal

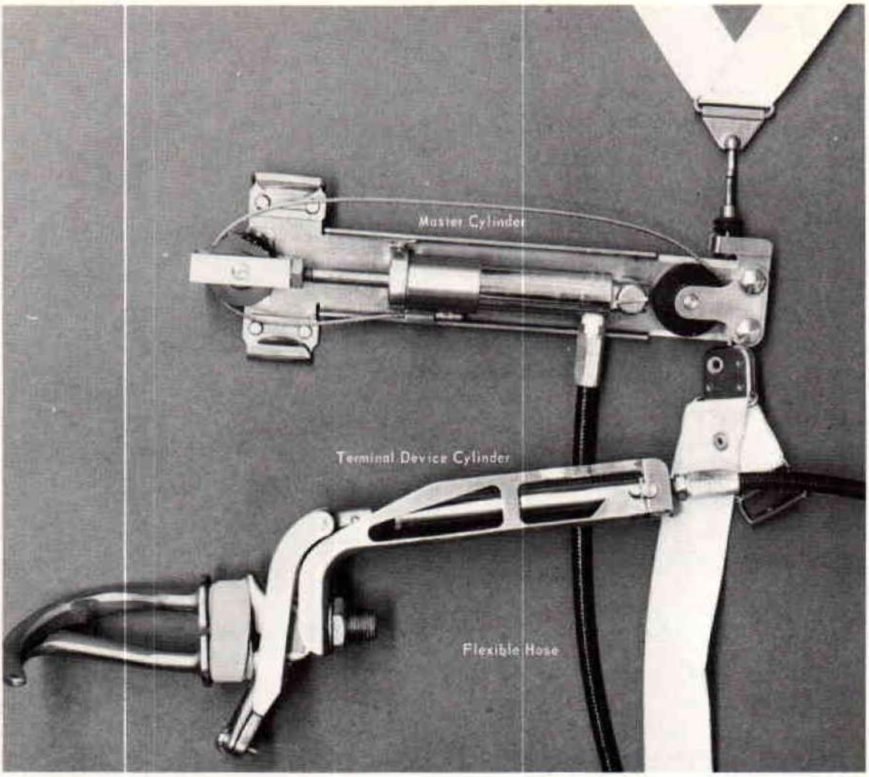

FIGURE 1—Body-Powered Hydraulically Operated Dorrance 5X Prosthesis.

cylinder equals $(7/16)^2 / (9/16)^2$ or 49/81. It was discovered in the first attempt to harness a small woman amputee that a better mechanical advantage was needed so the pulleys were added. This modification yields a ratio of displacement of the harness to displacement of the terminal device cylinder of 2 x 49/81 or 1.21. Preliminary experimental data indicates an overall system efficiency of approximately 80% when only 4 rubber bands are used on the terminal device. The system efficiency improves with increasing numbers of rubber bands as the seal friction in the hydraulic cylinders exists regardless of the number of rubber

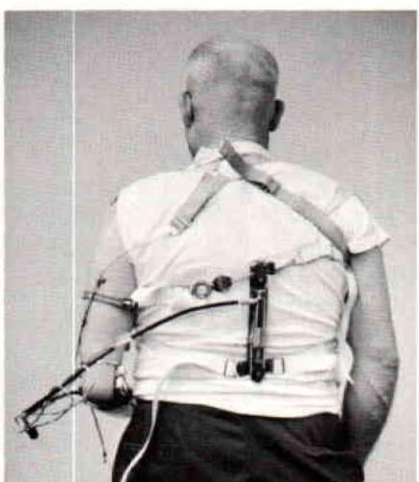

FIGURE 2—Body-Powered Master Cylinder and Bowden Cable Harness. Also, Transducer for Force Measurement.

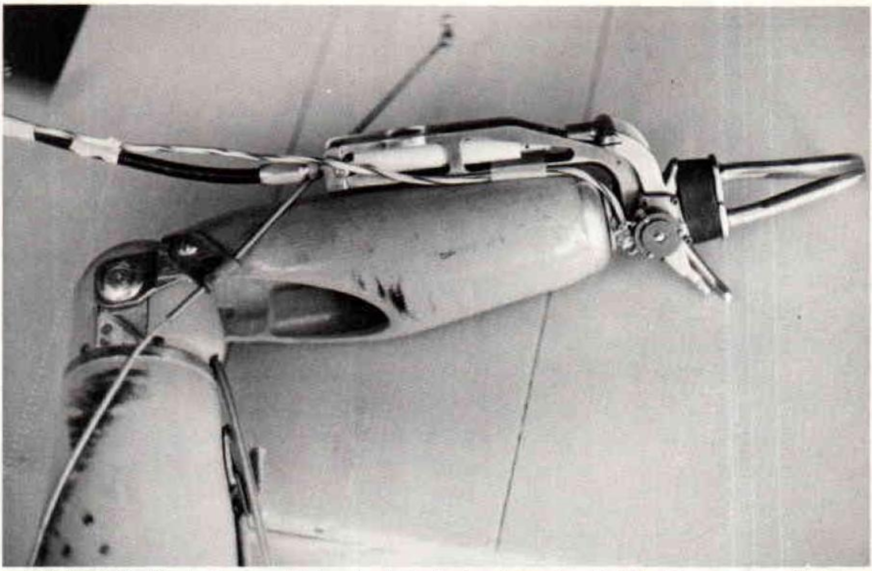

FIGURE 3—Body-Powered Terminal Cylinder, Bowden Cable Disconnected But Not Removed. Also, Transducer for Measuring Motion of Terminal Device.

bands on the terminal device. It may be worth commenting that the efficiency of the system is independent of the radius about which the flexible hydraulic tubing is bent. This same statement cannot be made regarding the Bowden cable system.

Some typical data related to the rubber bands on a Dorrance 5X terminal device are shown in **Table 1.** Due to the loose manufacturing tolerances maintained on the rubber bands, **Table 1** can be considered as representative only.

Table 1: Typical Data Related to Dorrance 5X Device.

No. of Rubber Bands	4	12
Max. Torque (inch-pounds)	30	110
Force on Lever at 1.875 inch (pounds)	16	59
Prehension at 4 inch Radius (pounds)	7	28

Considering the terminal device actuating cylinder with a cross-sectional area of 0.150 inch^2, the pressure required to overcome 12 rubber bands will be some 400 psi. The working pressure of the commercially available hose being used is 2500 psi with a burst pressure of 10,000 psi.

This information and experience to date suggests the trends for further work in the area of body-powered hydraulic devices. The sizes of the master and terminal cylinders will become smaller. This in turn will result in higher working pressures and increases in the overall system efficiencies. Harnessing for better utilization of the potential forces and excursions is presently being worked on. Minaturization of hydraulic components for orthotic and prosthetic applications brings its own problems—closer tolerances on sizes and finishes and greater care in assembly and maintenance. But miniaturization in hydraulics will come about—the question is whether or not the prosthetics and orthotics field will lead or follow in this transition.

Fig. 2 shows one initial attempt at harnessing an amputee with a body-powered hydraulically operated prosthesis. Some of the apparent complexity revealed in the photograph stems from the instrumentation of a force transducer as well as the harnessing used by the amputee for his Bowden cable.

Fig. 3 presents the terminal device actuator of the body-powered hydraulically operated system. The complicated looks are due, in part, to the instrumentation used for measuring the angular motion of the terminal device and the Bowden cable that was made inoperative but not removed from the prosthesis.

Electrohydraulic Unit

One can anticipate a need for orthotic and prosthetic devices that employ several forms of external power (i.e. other than body power). The system of **Fig. 4** illustrates one approach using hydraulic fluid as both a control and power transmission medium. The General Electric Company, as a subcontractor to the University of Virginia, deserves credit for work on this unit. This unit acts like power steering on an automobile.

With seven rubber bands on the terminal device of this electrohydraulic unit the application of about 3 pounds at the master actuator will initiate opening. By increasing the force at the master actuator, the terminal device will open farther. The terminal device will be completely opened with about 6 pounds applied to the master actuator. These force levels may be changed

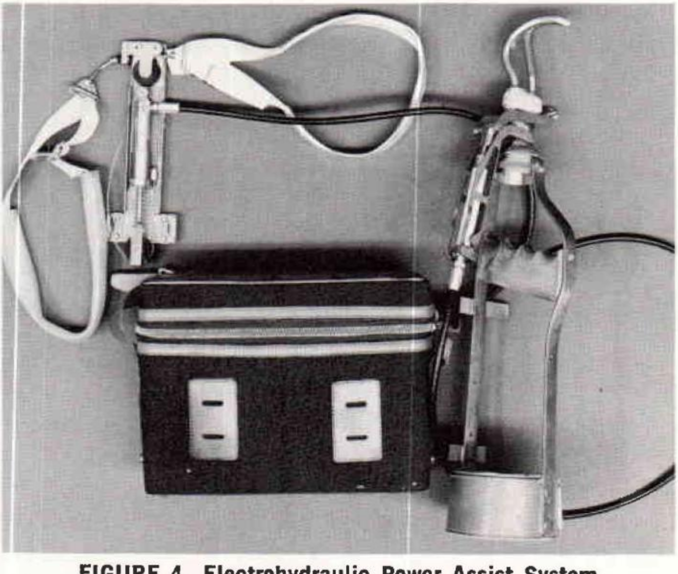

FIGURE 4—Electrohydraulic Power Assist System.

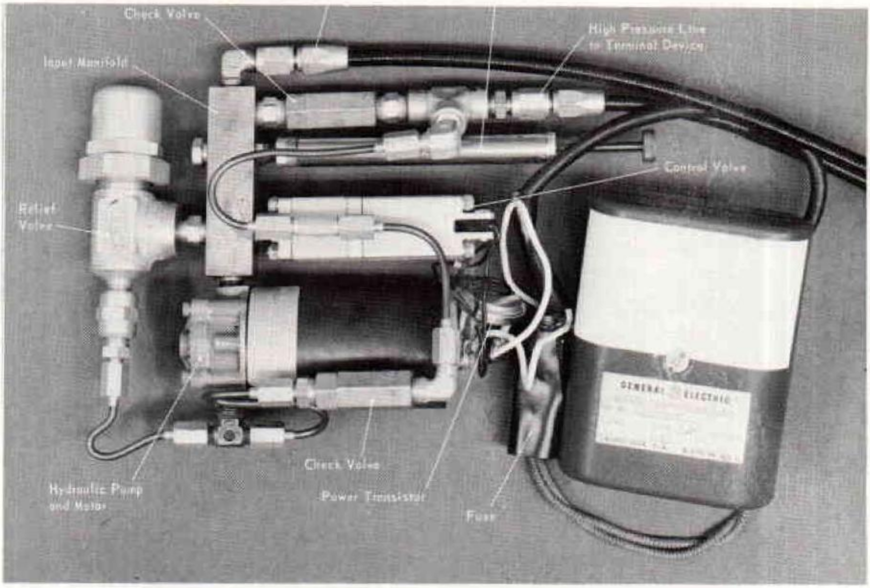

FIGURE 5—Details of Electrohydraulic Power Assist Unit.

by replacing springs in the control unit. One might anticipate using the prosthesis for light work (with few rubber bands on the terminal device) and not wish any external power assistance. At other times, a great deal more prehension might be called for and so also a need for power assistance.

Some of the details of the electrohydraulic power assist unit are shown in the photograph **(Fig. 5).** These details may be related as to function by considering the schematic diagram of the system of **Fig. 6.**

Operation of Electrohydraulic Unit

A description of the workings of this unit is best made by considering **Fig. 6.** A force applied to the master actuator (the cylinder that may be located on one's back) increases the pressure in the hydraulic fluid (Delco Supreme 550 hydraulic brake fluid). This pressure is transmitted to the terminal device actuating cylinder through the Control Valve. As the fluid pressure builds up, the Return Valve in the Control Valve closes. Then the path for fluid flow between the Master Cylinder and the Terminal Device is through the Check Valve. Increasing the force at the Master Cylinder will cause the spool within the Control Valve to displace farther and eventually reach a displacement that operates an electric micro-switch. When this happens, the electric motor is energized and through the hydraulic pump increases the pressure and fluid flow to the terminal device.

With the electric motor running, it is necessary to continue applying force to the Master Cylinder. If one stops displacing the Master Cylinder, that is if one does not maintain a force on the cylinder, the fluid pressure in this cylinder drops. This in turn means a drop of pressure in the Control Valve which is followed by motion of the spool within the Control Valve and this turns off the electric motor.

In order to close the Terminal Device, the force on the Master Cylinder must be decreased. Thus there is a range of force on the Master Cylinder over which no motion of the Terminal Device takes place. This means that a user can take less precaution in his overall actions and not cause either opening or closing of the device. A continued decreasing of force on the Master Cylinder will eventually allow the cylinder within the Control Valve to move to the point where the Return Valve opens. The Terminal Device will close in proportion to the motion of the Master Cylinder.

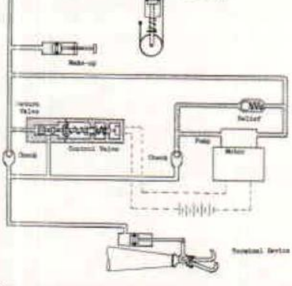

FIGURE 6—Schematic Diagram of Electrohydraulic Power Assist System.

For the case of no external power —i.e. the battery goes dead or is disconnected — everything happens as before except that the motor is not energized. Then the fluid from the Master Cylinder passes through the Check Valve toward the Terminal Device and behaves just like the body-powered hydraulic system. In short, it is a fail safe system that may be operated (if one has sufficient strength) with or without the power assist feature.

Summary

Breadboard models of the body-powered and electrohydraulic systems have been constructed. Some problems of the man-machine interface have been solved. Further input data on this interface problem is needed—data which you might be in a position to provide.

Hydraulics for orthotic applications seem to be a natural follow-on. To the present we have made no attempts to apply electrohydraulic systems in this area although we have considered the needs with patients.

Harnessing efforts are presently being pursued. Miniaturization of the systems are being considered. Hydraulic systems with different types of control and response characteristics are in order before the "best" scheme can be selected. Further testing will be required and then the manufacture of several prototypes will be in order.

ACKNOWLEDGEMENT

This work has been performed under Grant No. RD-1961-M of the Department of Health, Education, and Welfare, Vocational Rehabilitation Administration, Washington, D. C.

The Otto Bock All Plastic Above Knee Prosthesis for the Geriatric Amputee

BY FRITZ K. SCHROEDER, C.P.O. AND JOHN R. HENDRICKSON

Since the end of World War I, and especially following World War II, great efforts have been devoted to the improvement and development of new and better fitting techniques as well as more functional prosthetic components for the amputee. Inasmuch as most of the amputees involved have been comparatively young, it is only logical that not too much thought has been given to the needs of the geriatric amputee.

Today, however, as a result of advances made in the prevention, care, and management of disease, we can expect ever increasing numbers of older amputees. These older amputees require specialized attention.

Recognizing this situation, a conference on the Geriatric Amputee, sponsored by the Committee on Prosthetics Research and Development of the Division of Engineering and Industrial Research, was held at the National Academy of Sciences in Washington, D. C. Results of this conference are contained in Publication 919 entitled "The Geriatric Amputee."

In this publication, both Medical and Prosthetic Management Panels agree that the following specifics were desirable in prostheses for geriatric patients:

1. Minimum weight.
2. Articulated knee joint capable of providing knee stability.
3. Comfortable fit.
4. Secure suspension system easily donned.

With these recommendations in mind, Otto Bock Orthopedic Industry has developed a new, plastic knee/shin set-up with a manually operated knee lock and double frictions. It is designed for use in the fabrication of a lightweight all plastic above-knee prosthesis for the geriatric amputee. The knee lock mechanism is installed so as to provide sufficient space for the accommodation of long stumps. It is cable controlled and manually operated by a lever located near the lateral-proximal brim of the socket. However, if desired, it can be positioned anywhere on the socket for the needs of the amputee.

The set-up **(Fig. 1),** consists of a foam plastic shin and upper knee section together with a rigid plastic articulated knee mechanism. The knee lock and friction are installed in this knee section as supplied.

For the fabrication of the actual prosthesis, Degaplast acrylic resin is used; the resin is compounded according to specifications for application in the prosthetic and orthotic field. This resin is supplied in both rigid and flexible with a mixture of 80% rigid and 20% flexible being most desirable. For a soft inner socket, 100% flexible is used. A paste-type hardener and coloring pigment are the only other components required.

Although polyester resin may be used in the technique, we prefer acrylic resin for the following reasons:

1. It is non-toxic for the prosthetist as well as the amputee.
2. Being a thermo-plastic it lends itself to reheating and reshaping.
3. No post curing is required.
4. Thin wall lamination when our perlon and fiberglas tubing is used.
5. Easy to trim because lamination is thin.

The complete manual on the fabrication process includes 82 illustrations. Quite obviously, it is impossible, in this short article to do anything but touch lightly upon some of the highlights of the process. We offer it as one possibility for the geriatric A-K amputee.

Fabrication begins with a plaster impression of the stump. This is converted into a test socket having a reinforced proximal brim of sufficient strength to accept weight bearing **(Fig. 2).** The stump is fitted in the socket, modifications are made as necessary, and the amputee applies weight bearing while fit and size are checked by the prosthetist.

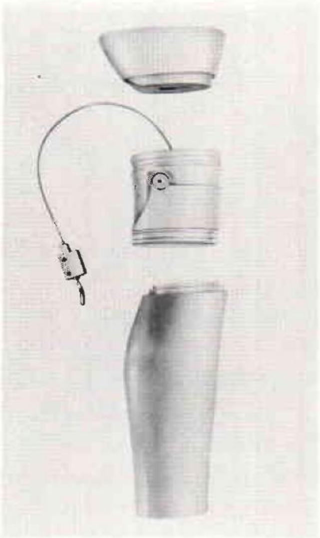

FIGURE 1

FIGURE 2

The test socket is filled with wet plaster and a two-way suction pipe is inserted **(Fig. 3).**

The positive cast is then prepared for lamination of the plastic inner socket. The lay-up consists of two layers of Perlon stockinette, two of fiberglass tubing, and two more of Perlon. If more strength is required for heavy amputees, additional layers may be added. This provides a thin, lightweight, yet rigid inner socket **(Fig. 4).**

Next, a layer of Perlon is pulled over the cured inner socket. This serves as a spacer. A PVC bag is pulled over this lay-up **(Fig. 5),** vacuum is applied, and a polyethylene sheet is wrapped around to contain the Pedilen #200 foam that is poured to give the bulk necessary for shaping the outer socket **(Fig. 6).**

The socket is then placed in a balancing jig **(Fig. 7),** which is used to determine optimum positioning of the socket. Reference lines are marked on the socket.

FIGURE 4

FIGURE 5

FIGURE 3

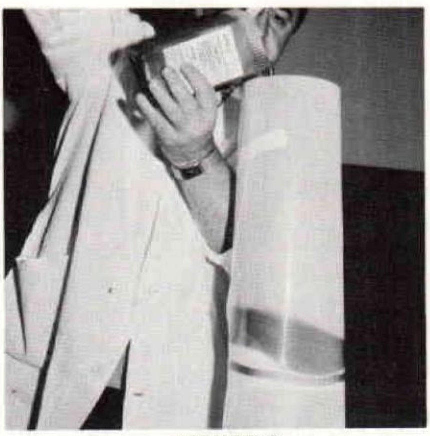

FIGURE 6

FIGURE 7

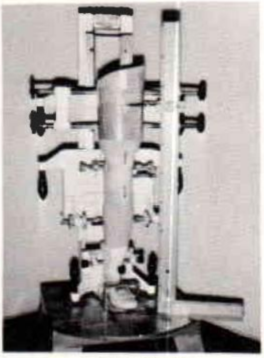

FIGURE 8

FIGURE 9

The foot and knee/shin set-up are then oriented into the alignment jig with the socket being brought into place in the same position previously determined by the amputee in the balancing jig. These components are aligned in relation to each other, cut to the desired length, and bonded together for test walking **(Fig. 8).**

After fitting has been completed, the shin and thigh are shaped down to the required measurements in preparation for lamination. A lay-up consisting of two layers of Perlon, two of fiberglass, and three more of Perlon stockinette is then applied **(Fig. 9).**

FIGURE 10

Upon completion of curing, the foam is removed completely **(Fig. 10).**

During the last National A.O.P.A. Convention at Miami Beach, this lightweight, all plastic A.K. prosthesis attracted considerable interest **(Fig. 11).** With this in mind, we are pleased to be able to describe some portions of the fabrication procedure and will be happy to supply additional details to anyone interested in the process.

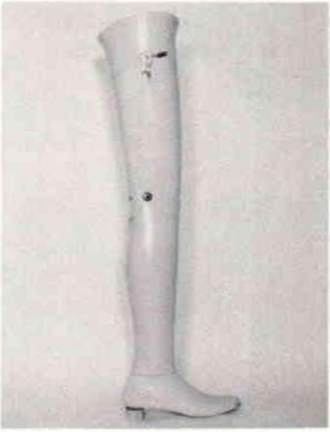

FIGURE 11

Twenty Months Experience with the "PTS"

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Many questions have been asked of prosthetists in our area about the "PTS Prosthesis," since it was first presented by Marschall and Nitschke in the June, 1966 and March, 1967, Orthopedic and Prosthetic Appliance Journal. We note that many people prefer to use other terms for this prosthetic fitting, such as "Modified PTB Prosthesis with Molded Supra-condylar—Supra-patellar Suspension," but for the sake of brevity, and not desiring to argue the point of terminology here, we will use the term of the original authors, "PTS".

The technical aspects of the PTS have been well presented by these two gentlemen in Journal Articles, National Assemblies, and Regional Meetings in the past. Therefore, we will not even touch on technical aspects, but confine ourselves to answering those questions concerning, "how extensively have you used the PTS, what type of patients and stumps can be fitted with it, how successful has it been, how do you, as a prosthetist, like the PTS, etc.?"

The following charts show statistics on each individual patient fitted with a PTS Prosthesis in our two facilities in Syracuse and Rochester, during a twenty-month period from May, 1966, through December, 1967.

Ninety-four patients (28 female and 66 male) are shown in this study, of which three were bilateral below-knee amputees fitted bilaterally with the PTS, making a total of ninety-seven below-knee stumps fitted with the PTS prosthesis. These ninety-seven represent 100% of all PTS attempted, and 35% of the total number of below-knee prostheses fitted during the same period. At the same time, 26% of all BK amputations were fitted with PTB, and 39% had side joints and thigh lacer incorporated into their prostheses.

All ninety-seven were prescribed by, and followed to various extents, by a prosthetic clinic or an individual physician. None of the patients were selected on the basis of being used in a study, but were selected, utilizing normal prescription criteria, and with the intent that the PTS was the best prosthesis for the individual. However, some were prescribed when chronic stump problems persisted with other types of prostheses, and no other alternative was found.

The age shown in the chart is the patient age at the time of the first PTS fitting. The ages range from seven to eighty-nine, and average fifty-two. There was no reluctance to fit someone younger than seven, but there were none presented. Age did not appear to be a significant criterion in the prescription, fitting, or success of the prosthesis.

The amputation date shown in the chart is the last amputation or major surgical revision of the stump, prior to PTS fitting. The length of time between surgery and prosthetic fitting did not appear to be any greater or any less with the PTS. Neither did stump shrinkage, or atrophy appear to cause any greater need for, or less need for, replacement sockets.

Many of the listed causes of amputation are very general, but we think sufficiently self-explanatory for this paper. No evidence was found that would indicate that the PTS should, or should not, be used with any specific cause of amputation. It was noted numerous times, in patients who had previously shown problems of edema or breakdown at the distal end of the stump, that when they were fitted with the PTS, the problem areas cleared up and the problems were eliminated. In our opinion, this indicates less proximal restriction in this prothesis.

Stump lengths were measured from the medial tibial plateau to the end of the stump and these ninety-seven range from a short 2¾ inches to a long 12 inches. We found that we could successfully fit many short stumps with the PTS, which we could not fit with the PTB. Long stumps presented no problems in donning and removing the PTS, as some people had anticipated.

Twenty-one preparatory prostheses were fitted, fifteen PTS and six PTB. Some of the preparatory sockets were plaster of Paris and some with soft inserts, but no record was kept on how many of each. The decision to fit or not to fit preparatory prostheses was determined merely by the physician's opinion of "early fittings" and is incidental to this paper.

In forty cases, the PTS was the first type of prosthesis fitted (including preparatory PTS). Fourteen cases changed directly from a prosthesis with side joints and thigh lacer, and forty-three from PTB. A discussion of these results follows in later paragraphs.

Occupational classifications are general and fail to show the activities followed by the individual, which in many cases does not indicate how extensively the prosthesis is being used. While classifications such as Construction and Machinist indicate hard use of a prosthesis, the term Retired would tend to indicate light use, however, in many of these Retired cases it means more extensive use, such as part time jobs, or hunting, fishing, etc.

We have attempted to evaluate the Results Column very realistically and without prejudice. While judgment enters into this considerably, we have in all cases arrived at the result after consultation with the patient and/or the physician.

In only eleven instances out of the ninety-seven, the PTS was not the prosthesis of preference to the patient. However, two of the eleven are still wearing it. These two patients preferred the PTB to the PTS, but rather than altering their present PTS, their wishes were to wait until they could be fitted with a new PTB. We anticipate that by the time that they are ready for a new prosthesis, they will want to stay with the PTS fitting.

It was completely and flatly rejected by only three cases, two of those during the dynamic alignment period. One of the two went back to a conventional below-knee prosthesis and with the other one, the proximal trim lines were cut to those of a PTB and dynamic alignment completed. The other patient could not tolerate total weight bearing on the stump after a few months, and in this case the brim was cut to allow for the addition of side joints and thigh lacer, resulting in a satisfactory prosthesis.

Six of the eleven cases wore the PTS for short periods of time and decided that they preferred the PTB, with which they had been quite happy previously. In four of these six cases, the PTS trim lines were cut to the level of PTB trim lines with no adverse effect to the alignment of the prosthesis, and a satisfactory PTB fit was maintained. In the other two, realignment of the prosthesis was necessary, and with one of the two a new socket was necessary, leaving speculation as to the fit of the socket as a PTS. None of these six people actually rejected the PTS, but their preference was the PTB.

The most consistent reason for PTB preference (six patients) was that the PTS was larger around the knee and with today's tight trousers, it caused more bulk inside the trousers. Two others had trouble kneeling. It should be recognized though, that all of these people had worn the PTB for some considerable length of time and were very happy with it.

One patient was discontinued from any prosthesis by her physician, due to her medical condition.

Five patients were rated as "Questionable" and with most of these we feel that they would probably be rated the same in any type of prosthesis.

Eighty of the ninety-seven are rated as Satisfactory and Very Satisfactory. Naturally, a number of these might well have been rated the same in other types of prostheses also. But we do want to point out that there are a number of these with short stumps, unstable knee joints, etc., that we would not have even attempted to fit with the classic PTB. Acceptance by these patients ran very high in cosmesis, function, and comfort, and many felt that this was by far the finest type of prosthetic fitting they have ever had.

We naturally wish now that comparative statistics had been kept on patients fitted with other types of below-knee prostheses during the same period of time, so that more complete comparisons could be made.

Eight of the definitive PTS Prostheses in this study were hard sockets with foam ends, while the remainder had soft (UCB type) inserts.

Summary

We do not intend this paper to take anything away from the PTB or other types of below-knee prostheses, but merely show, statistically, that the PTS has had extensive clinical application and that it is another type of socket modification that the prosthetist has available to fit some of the many below-knee amputation problems he is faced with daily. It has proven to be highly acceptable to most amputees. We have seen some problem stumps fitted successfully with it when we could not do so with other types of prostheses. Physicians who have had experience with the PTS have accepted it highly. We feel that any prosthetist, who is skilled in PTB fitting can, following Nitschke and Marschall instructions and applying his own ability and experience, satisfactorily fit the PTS.

We feel that the PTS Prosthetic Fitting is "here to stay" and should be another consideration when a patient is being evaluated for a prosthetic prescription.

Identifi- Age

Identification	Age	Amputation Date	Cause	Stump Length	Preparatory PTB	Preparatory PTS	PTS Date		Other Prostheses Type	Other Prostheses Date	Occupation	PTS Results & Remarks
1879 M	52	6-19-65	Diabetic Gangrene	5-3/4"			5-66	11-67			Clerk	Very Satisfactory
1951 M	32	1-12-66	Fibro-Sarcoma	4-1/2"		6-66	8-66				Construction	Satisfactory – Deceased 10-67
1976 F	79	5-20-66	Arteriosclerosis	6-1/2"		6-66	9-66				Homemaker	Questionable
1991 F	56	5-64	Vascular	2-3/4"			6-66				Homemaker	Satisfactory
2097 F	15	7-19-58	Congenital Deformity	3-1/2"			7-66		Conv. PTB	1958-1961 4-61, 1-62, 9-62, 12-63, 3-65	Student	Very Satisfactory Has very unstable knee
2182 M	55	6-20-66	Arteriosclerosis	5-1/2"	9-66		12-66	11-67			Machinist	Satisfactory
2205 M	76	4-22-63	Traumatic	5-3/4"					Conv. PTB	1963 7-66	Retired	Rejected PTS 7-66 Deceased
2368 F	80	9-10-66	Diabetes	6"		9-66	12-66	5-67			Homemaker	Satisfactory
2369 F	78	2-2-66	Arteriosclerosis	3-1/4"			9-66				Housewife	Questionable
2372 F	52	3-65	Traumatic	6"			9-66		Conv.	7-65	Housewife	Stopped wearing any prosthesis, due to medical reasons
2384 M	59	9-56	Tumor	5"			9-66		Conv. PTB	1956-1961 3-61, 5-63	Physician	Satisfactory
2391 M	40	12-2-65	Traumatic	6"			9-66	11-67	Conv.	1966	Retired	Satisfactory – Numerous other disabilities
2460 M	24	2-18-63	Osteomyelitis	6"			10-66		PTB	1963	Auto Mechanic	Satisfactory – Prefers PTS
2461 F	22	12-15-64	Traumatic	5"			10-66		Mod. PTB w/ ischial bearing	11-65	Secretary	Satisfactory – Fractured femur, require ischial bearing early
2466 F	23	1944	Congenital	5-1/4"			10-66		Conv. PTB	1946-1961 1961	X-ray technician	Satisfactory – No Patella present
2513 M	75	9-30-66	Arteriosclerosis	5-3/4"		11-66	1-67				Retired	Satisfactory
2520 M	65	5-12-66	Vascular	6-1/4"	6-66		11-66				Retired	Very Satisfactory
2528 M	56	8-7-66	Traumatic	7"			11-66	3-67	PTB w/ corset	5-67, 12-67	Industrial Maintenance	PTS did not work out, very sensitive stump
2532 F	65	5-24-66	Diabetes	3-1/2"			11-66	5-67			Homemaker	Satisfactory – Now ready for new socket
2543 M	74	11-61	Arteriosclerosis	3-1/4"			11-66		PTB	7-61, 7-62, 4-63, 6-65, 8-66	Executive	Satisfactory – Deceased 5-67
2571 F	25	3-66	Traumatic	4"			11-66				Unemployed	Satisfactory – New socket presently indicated
2606 M	74	11-58	Traumatic	5-1/2"			11-66		Conv. PTB	1958-64 & 9-67 12-64	Caretaker	Rejected PTS, went back to Conv.
2628 M	51	9-8-65	Traumatic	4"			11-66		Conv.	1965	Self employed construction	Satisfactory
2691 M	50	4-26-66	Arteriosclerosis	8"			12-66				Salesman	Satisfactory
2696 M	47	4-2-63	Traumatic	5-1/4"			12-66		PTB	6-63, 2-64	Carpenter	Satisfactory – Prefers PTS
2709 M	40	3-10-54	Traumatic	4-1/2"			12-66		Conv. PTB	1954-1962 12-62, 7-63, 11-64	Small engine Mechanic	Rejected PTS 2-67, due to difficulty kneeling while working
2752 M	32	1952	Traumatic	5"			12-66		Conv. PTB	1953-1964 1964	Farmer	Questionable
2756 M	25	3-26-52	Traumatic	3"			12-66		Conv. PTB	1952-1961 4-61, 12-62	Salesman	Changed back to PTB 2-67, bulk around knee
2805 F	19	9-5-64	Traumatic	3"			1-67	10-67	PTB w/ quad. ischial A/K socket	4-65	Student	Satisfactory – Removed quad. brim & used std. corset til fitted w/PTS
2815 M	35	11-1-51	Traumatic	8-1/4"			1-67		Conv. PTB	1951-62 & 4-66 7-62, 7-63, 1-65	Insurance claims	Satisfactory – Tried all types & had problems, PTS OK to date
2873 M	41	10-8-61	Traumatic Bilateral	R. 7" L. 6"			R. 1-67		PTB w/ corsets	R.&L. 1961-66 8-66	Operated store	Questionable – Corset on left, PTS on right

Identification	Age	Amputation Date	Cause	Stump Length	Preparatory		PTS		Other Prostheses		Occupation	PTS Results & Remarks
					PTB	PTS	Date		Type	Date		
2874 M	30 *	8-4-66	Traumatic Bilateral	R. 6-1/2" L. 12"		L. 11-66	L & R 1-67				Janitor	Satisfactory
2936 M	72	3-18-58	Diabetic	8-1/4"			2-67		Conv. PTB	1958-1962 8-62, 11-65	Retired	Very Satisfactory
2987 M	47	9-7-46	Traumatic	5-1/4"			2-67		Conv. PTB	1946-1962 10-62, 8-64	Machinist	Satisfactory
2999 M	62	2-67	Vascular	5-1/4"		3-67					Unemployed	Satisfactory – Unable to follow for definitive
3015 M	37	10-3-52	Traumatic	5-1/2"			3-67		Conv. PTB	1952-1961 4-61, 12-62, 12-64	Bookkeeper	Rejected PTS – Presently refitting with PTB
3026 F	29	7-30-65	Traumatic	5-3/4"			3-67		PTB	1-66	Housewife	Very Satisfactory
3040 M	41	11-26-55	Traumatic	9-3/4"			3-67		Conv. PTB	1955-1962 1962-1967	Electrician	Very Satisfactory
3043 M	55	L. 11-20-66 R. 5-14-67	Diabetes	L. 5" R. 5-7/8"			L. 3-67 R. 9-67				Retired	Very Satisfactory
3102 M	65	2-2-66	Arteriosclerosis	5"			3-67				Retired	Satisfactory – Deceased 10-67
3110 F	76	2-26-66	Vascular	5-7/8"	12-66		3-67				Housewife	Satisfactory
3124 M	64	2-1-49	Traumatic	5-1/2"			3-67		Muley PTB	1949-1961 5-61, 5-64	Retired	Satisfactory & has been on any prosthesis
3127 M	26	3-17-67	Traumatic	5"		3-67	5-67	10-67			Construction	Satisfactory – Operates heavy equip.
3130 M	77	3-14-67	Arteriosclerosis	6-3/4"		5-67	8-67				Retired	Satisfactory
3131 M	59	1-18-65	Vascular	6-1/4"			3-67		PTB	6-65	Banker	Satisfactory
3149 M	41	3-8-66	Vascular	8"	4-66		4-67		PTB w/ corset	7-66, 10-66	Mechanic	Satisfactory
3223 F	31	8-56	Traumatic	5-1/2"			4-67	12-67	Conv. PTB	1956-1963 8-63, 8-64	Housewife	Satisfactory – Bird hunts, very active
3242 M	46	6-2-42	Traumatic	6-1/2"			4-67		Conv. PTB	1942-1962 12-62, 5-64	Truck driver	Rejected PTS – Brim cut down to PTB 6-67
3255 M	43	1-5-66	Osteomyelitis	6-1/4"			4-67		PTB w/ corset	4-66	Retired	Satisfactory – other disabilities
3304 F	67	2-14-67	Arteriosclerosis	5-1/2"	3-67		5-67	11-67			Housewife	Very Satisfactory
3316 M	58	L. 12-23-66 R. 6-67	Arteriosclerosis	L. 5-1/2"			L. 5-67		R. prep. A/K	8-67	Machine layout	Satisfactory
3364 M	64	5-1-67	Diabetes	5"		5-67	9-67				Parole Officer	Satisfactory – Blind
3369 M	54	1958	Osteomyelitis	5"			5-67		Conv. PTB	1958-1962 5-62, 11-64	Mechanic	Questionable
3377 F	77	6-66	Diabetic Gangrene	7-1/4"			5-67				Homemaker	Satisfactory
3384 F	45	10-21-65	Traumatic	5"			5-67		PTB w/ corset	3-66	Housewife	Satisfactory
3417 M	70	1921	Traumatic	7"			6-67		Conv.	1921-1967	School-crossing guard	Satisfactory – Distal end problems other pros. no problems to date
3439 M	33	8-64	Traumatic	7-1/2"			6-67		PTB	12-64, 8-65	Engineer	Very Satisfactory
3468 F	48	10-2-66	Traumatic	4"			6-67		PTB	3-67	Housewife	Very Satisfactory
3527 M	41	1945	Traumatic	6-1/4"			6-67		Conv. PTB	1946-1962 1-62, 12-66	Administrator	Satisfactory – Other amputations R.B/E.LP/H L Syme
3529 F	68	1-67	Diabetic Gangrene	5-1/4"			6-67				Homemaker	Satisfactory
3549 M	64	7-17-64	Arteriosclerosis	4"			7-67		PTB	12-64, 12-65	Foreman	Satisfactory – Opposite leg amputated 11-67 not fitted
3578 M	42	5-8-45	Traumatic	5-1/2"			7-67		Conv. PTB	1945-1961 8-61, 8-64, 12-66	Clerk	Rejected PTS prefers PTB
3589 M	63	4-29-67	Diabetic Gangrene	7-1/4"			7-67				Retired	Satisfactory

Identification	Age	Amputation Date	Cause	Stump Length	Preparatory PTB	Preparatory PTS	PTS Date		Other Prostheses Type	Other Prostheses Date	Occupation	PTS Results & Remarks
3609 M	45	2-15-67	Vascular	4-1/4"			7-67				Drives Florist truck	Satisfactory
3611 M	73	12-30-61	Traumatic	5"			7-67		PTB	6-62, 1-63, 9-63, 8-64, 5-66	Mechanic	10-67 PTS brim cut down to PTB, realignment on Adj. leg
3616 M	41	3-5-54	Traumatic	5"			7-67		Conv. PTB	1954-1961 4-61, 6-63, 4-66	Operating Engineer	Very Satisfactory
3632 M	35	1-11-67	Traumatic	8"			7-67	12-67			Logging Truck driver	Very Satisfactory
3703 M	65	6-66	Diabetic	7"			8-67				Retired	Satisfactory
3726 M	55	12-65	Gangrene	6"			8-67		Conv.	4-66	Homemaker	Satisfactory
3727 M	26	1945	Traumatic	4-3/8"			8-67		Conv.	1946-1967	Engineer	Satisfactory
3773 F	63	7-20-67	Arteriosclerosis	5-3/4"		8-67	11-67				Homemaker	Apparently Satisfactory – Deceased 12-67
3818 F	42	1952	Traumatic	8-1/4"			8-67		Conv.	1952-1967	Carnival Worker	Satisfactory
3864 F	66	1962	Arteriosclerosis	5-5/8"			9-67		PTB	1962-1967	Housewife & Bookkeeper	Satisfactory
3901 M	85	7-13-62	Vascular	3-1/2"			9-67		PTB	1962-1967	Retired	Rejected PTS cut back to PTB 12-67
3922 M	64	8-10-67	Arteriosclerosis	5-1/4"		9-67	12-67				Operates Restaurant	Satisfactory
3931 F	16	9-56	Traumatic	7"			9-67		Conv. PTB	1956-1962 5-62, 5-65, 8-66	Student	Very Satisfactory
3946 M	64	6-67	Diabetes	7-1/4"			10-67				Retired	Satisfactory
3949 M	75	1953	Traumatic	6"			10-67		Conv. PTB	1953-1960 11-60	Retired	Does not find any differance in comfort
3953 M	49	1946	Traumatic	5-3/4"			10-67		Conv. PTB	1946-1962 7-62, 6-63	Inspector	Very Satisfactory
3966 F	71	1-11-65	Diabetes	5"			10-67		Conv.	11-65, 5-66	Housewife	Satisfactory
4007 M	69	10-1-67	Arteriosclerosis	5-3/4"		10-67 12-67					Physician	Very Satisfactory
4067 M	35	4-7-56	Traumatic	3-1/8"			PTB 11-67		Conv. PTB	1956-1962 1962-1967	Postal Clerk	Rejected PTS during dynamic & fitted as PTB
4074 F	51	1924	Gangrene	7-1/4"			11-67		Conv. PTB	1924-1963 3-63	Restaurant Hostess	Satisfactory
4090 M	75	7-1-67	Diabetic Gangrene	6"	7-67		11-67				Retired	Satisfactory
4093 M	70	L. 1938 R. 1948	Frostbite Bilateral	L. 7" R. 7"			11-67		Conv. PTB	1938-1960 1960-1964	Prosthetist Orthotist	Very Satisfactory
4117 F	75	8-28-67	Diabetic Gangrene	4-3/8"			11-67				Homemaker	Satisfactory
4131 M	24	4-22-65	Traumatic	7"			11-67		PTB Conv.	8-65 4-66	Maintinance	Satisfactory
4140 F	18	1949	Congenital	9"			11-67		Conv. PTB	Dates not available	Student	Satisfactory
4154 M	89	8-67	Vascular	5-3/4"		8-67					Retired	Very Satisfactory – Deceased 12-67
4167 M	57	1962	Traumatic	5-1/2"			11-67		PTB	several 1962-1967	Toolmaker	Very Satisfactory
4205 F	7	1963	Correct congenital deformity	7-5/8"			12-67		PTB	1963-1967	Student	Very Satisfactory
4218 M	71	R. 11-28-66 L. 11-67	Arteriosclerosis Frostbite	R. 7-1/2" L. 8"			R. 12-67		R. PTB	3-67	Retired	Satisfactory
4229 M	61	8-14-67	Vascuiar	6-1/4"			12-67				Cabinet builder	Satisfactory
4260 M	25	10-5-67	Traumatic	6"		12-67					Engineer	Satisfactory

Dynamic Splinting of the Rheumatoid Hand

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Editor's note: *Subsequent to publication of this article in the December, 1967 issue of* Orthotics and Prosthetics, *it was brought to our attention that the authors had prepared additional conclusions and an Addendum. Footnotes concerning the authors were also included. Rather than publish only the additional material, in which case it would be necessary to refer to two sources for complete information, we are reprinting the entire paper for your convenience.*

The effect of orthotic devices in the modification of hand deformities in rheumatoid arthritis is essentially unknown. Immobilization of acutely involved joints has long been known to provide symptomatic relief, and it was recently shown that immobilization also results in local improvement of joint involvement. (1) (2) Beyond this, however, little is known about the prevention of deformities caused by rheumatoid disease.

There is little agreement as to the significance of multiple factors in causing rheumatoid hand deformities, but there is a consensus among most authorities that synovitis, capsular distension and instability are the primary etiologic features. Mechanical stresses of various types superimposed upon an unstable joint then result in progress deformities. (3) (4) (5) Intimately associated with the soft tissue involvement is the destruction of articular cartilage and bone.

Many clinicians believe that prolonged splinting to protect diseased joint from the adverse effects of mechanical stress might prevent or retard the development of typical deformities. This contention, however, has not been established. The ideal splint, as described by Bennett, "must

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permit the normal planes of motion necessary for essential function, but block all faulty planes that result in functionally significant deformity." (6)

For the past seven years, a dynamic hand splint designed to maintain motion, improve function, relieve pain and prevent the progression of deformity has been used on the Rheumatoid Arthritis Service at Rancho Los Amigos Hospital. The device **(Fig. 1)** is similar to the paralytic splints found to be valuable in the rehabilitation of patients with residual deficits from poliomyelitis and spinal cord injuries. The splint **(Fig. 2)** has an action wrist, an action metacarpophalangeal joint with extension assist and plastic loops to support the proximal phalanx and apply a radial deviation force.

MATERIAL

During the period 1959 to 1965, sixty-one patients with definite rheumatoid arthritis were fitted with this splint. Ten patients who later underwent surgical procedures were not included in the series. Twenty-two patients (42%) wore the splint for more than one year and thirty-one patients (58%) used the splint for less than a year. Of these thirty-one, nineteen patients (36%) would not wear them at all.

Twenty-seven hands in seventeen patients, who wore the splints one to five years with a mean use period of thirty-four months, are available for review. Thirteen hands in eight patients, who were fitted but did not use the splints and were evaluated more than one year after fitting with a mean follow-up of thirty-two months, are available for comparison. The mean age of the splinted group was forty-six years, and the comparison group forty-eight years.

RESULTS

Function:

The splint is bulky and cumbersome, and in many cases hand function was reduced. The patients with the least deformity were the ones who disliked the splints the most. It seemed that the splints decreased function in inverse proportion to the degree of deformity present. Despite many attempts, it was not possible to document increased hand function while using the splints.

Wrist:

The splints adversely affected motion in those wrists that had good extension at the beginning of the program. **(Fig. 3-A)** Thirteen wrists were in this group—eleven lost extension, eight lost flexion range, and three developed significant deformities. The mean loss of total range in this group was forty-seven degrees.

In the wrists with pre-existing deformity **(Fig. 3-B)** the adverse effects were not so apparent. One wrist in fourteen was improved, but there was progression of deformity in three others. The mean loss of total range in this group was only eight degrees, which is probably not a significant figure, but does indicate that wrist motion was not increased.

In the comparison group the

mean extension range was thirty-seven degrees—a mean loss of extension of five degrees with a mean loss of total range of only seven degrees.

Metacarpophalangeal Joint:

The development of metacorpophalangeal joints that had full passive extension at the beginning of the study developed flexion deformities. **(Fig. 4)** In addition, thirty-nine per cent of these joints lost flexion range with a mean loss of total passive motion of fifteen degrees.

Correction of flexion deformities of the metacarpophalangeal joint was not consistently achieved. **(Fig. 5)** Nineteen metacarpophalangeal joints had a flexion deformity at the onset of the splint program. Of these, eight improved, eight were worse and three did not change. In addition, five more joints developed flexion deformities during the splinting program. The mean loss of total motion in this group was thirteen degrees.

In the comparison group twelve per cent of the metacarpophalangeal joints developed flexion deformities and thirty-two per cent lost flexion range. The total range, however, was essentially unchanged.

Proximal Interphalangeal Joint:

The proximal interphalangeal joint was not directly splinted, but the mechanics of this joint were altered by the splinting of the metacarpophalangeal joint. Splinting seemed to adversely affect this joint also, in that there was a mean loss of total range of fifteen degrees, which can be compared to a mean loss of seven degrees in the group that would not use the splints. This may not be a significant change.

DISCUSSION

It must be emphasized that this is a very select group of patients. The fact that these patients were cared for at Rancho Los Amigos Hospital indicates that their disease was most often of severe magnitude, of prolonged duration, and usually not amenable to out-patient management. Furthermore, an artificial selection occurred, in that most data was recorded during in-patient treatment, which eliminated some patients that were in remission or lost to follow-up.

The data recorded throughout was that obtained by passive motion. There are many deficiencies in this method, particularly at the metacarpophalangeal joint. It was felt, however, that because of the wide variations in active motion, depending upon the amount of pain present, that passive motion was a more consistent and thus reliable figure.

The group of patients used for comparison is extremely small. The term "Control" has been purposefully and carefully avoided, for in no sense of the word can this group be considered a control. The difficulties involved in attempting to match patients with rheumatoid disease for control purposes have been widely stated. Many of these patients were fitted bilaterally and some had surgical procedures on the opposite hand, thus eliminating the opposite hand as a control. However, the comparison group does match well in terms of age, duration of follow-up and presumably the nature of their disease.

All of the patients in this series, in addition to being splinted, underwent a regular in-patient regimen of occupational and physical therapy designed to increase motion and strength, as well as correct or prevent deformity. It is not possible to separate the effects of this program as distinct from those occurring as a result of splinting. The comparison group also took part in this program, but the number of variables and size of the group prevents any real observation in this regard.

CONCLUSIONS

Present hand splinting techniques and design are inadequate in rheumatoid arthritis of the hand. This study does not pretend to demonstrate that the rheumatoid afflicted hand would not be amenable to a more scientifically designed or functionally oriented splint.

A review of fifty-one patients with rheumatoid arthritis that were fitted with a dynamic hand splint, designed and used on the Rheumatoid Arthritis Service at Rancho Los Amigos Hospital, suggest the following:

1. Hand function was not increased while using the splints.
2. Progression of deformity was not consistently prevented.
3. Correction of pre-existing deformity was not effectively achieved.
4. Limitation of joint motion occurred that was probably greater than would be expected if the hands had not been splinted.

ACKNOWLEDGEMENTS

The conscientious and dedicated effort of the occupational therapists of Rancho Los Amigos Hospital must be acknowledged. Without their frequent, tedious and laborious recording of joint range, this paper would not be possible.

ADDENDUM

Based on the findings of this study, a new splint specifically for rheumatoid arthritis of the hand has been designed. Its use shows promise in fulfilling the following criteria:

1. Reduction of pain.
2. Delay or prevention of deformities.
3. No significant decrease in the function of the hand while the splint is being worn (a number of cases have actually demonstrated increased hand function).

This splint will be described in a later report after the results from the current control study and its clinical application can be correlated over an adequate period of time.

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A Modified Modification

(Cosmetic Improvement of a Good Product)

SIEGFRIED W. PAUL, C.P.O.
Director, Orthotic and Prosthetic Department
Newington Hospital for Crippled Children

One of the more recent newsletters of the A. J. Hosmer Corporation introduced a variation of the Northwestern University developed hip disarticulation hip joint as now commercially available.

The added technical feature consists of a lever arrangement providing stride control and stability of the hip joint during the walking cycle.

Mr. Carlton Fillauer of Fillauer Surgical Supplies, Chattanooga, Tenn. is to be credited with the passing on of the basic idea which has been used by him for several years.

This "home made" modification of a standard H.D. prosthetic hip joint had in its simplicity a feature not present in the Hosmer engineered product. Mr. Fillauer's approach offered cosmesis along with excellent joint and stride control eliminating the Hip-Knee strap of the Canadian design.

The Hosmer product is combining the hip stride control with the Northwestern University joint causing cosmetic problems due to the anterior and proximal located axis of the hip stride control lever.

Our approach to better cosmesis without loss of the excellent technical features is illustrated in the pictures one through three.

The modification consists of the following changes:

The socket attachment plate has been milled out of 2024 Duraluminum stock as one solid unit. **(Illustration #1)** We eliminated the spherical washer adjustable unit which in our experience is helpful but not a necessity. The hip joint axis could therefore be located in a much closer proximity to the socket. It became also possible to orient the axis for the hip stride control lever at the anterior surface of the socket eliminating any anterior protrusion.

We utilized the original set up block (after notching of the bars to prevent separation from the plastic) and the hip stride control lever.

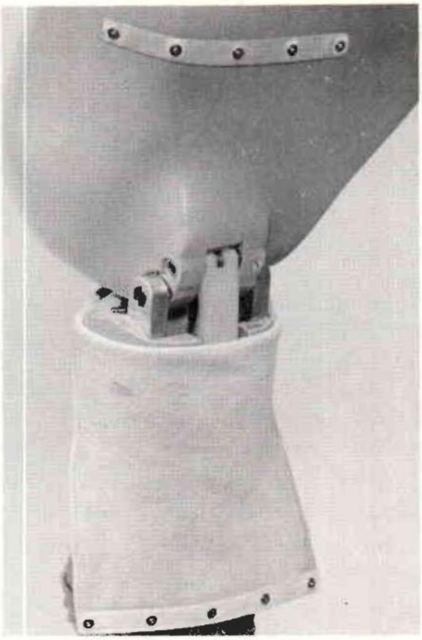
Dynamic alignment of the socket in relation to the lower prosthesis was easily obtained by using wedges inserted between the flush surfaces of the attachment plate and the prepared socket.

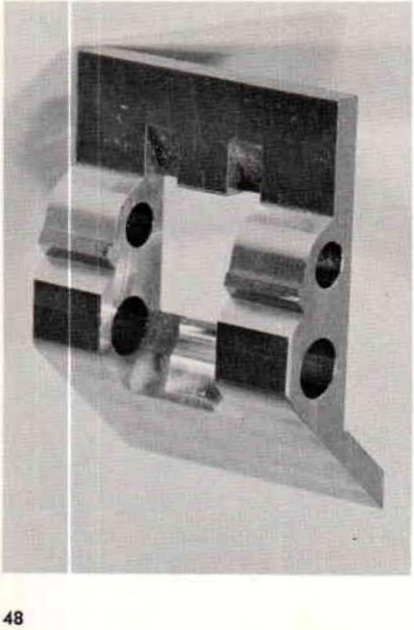
Illustration number 1 demonstrates the plate after completion of the milling process and does not show the later on applied holes fitting the four socket attachment bolts.

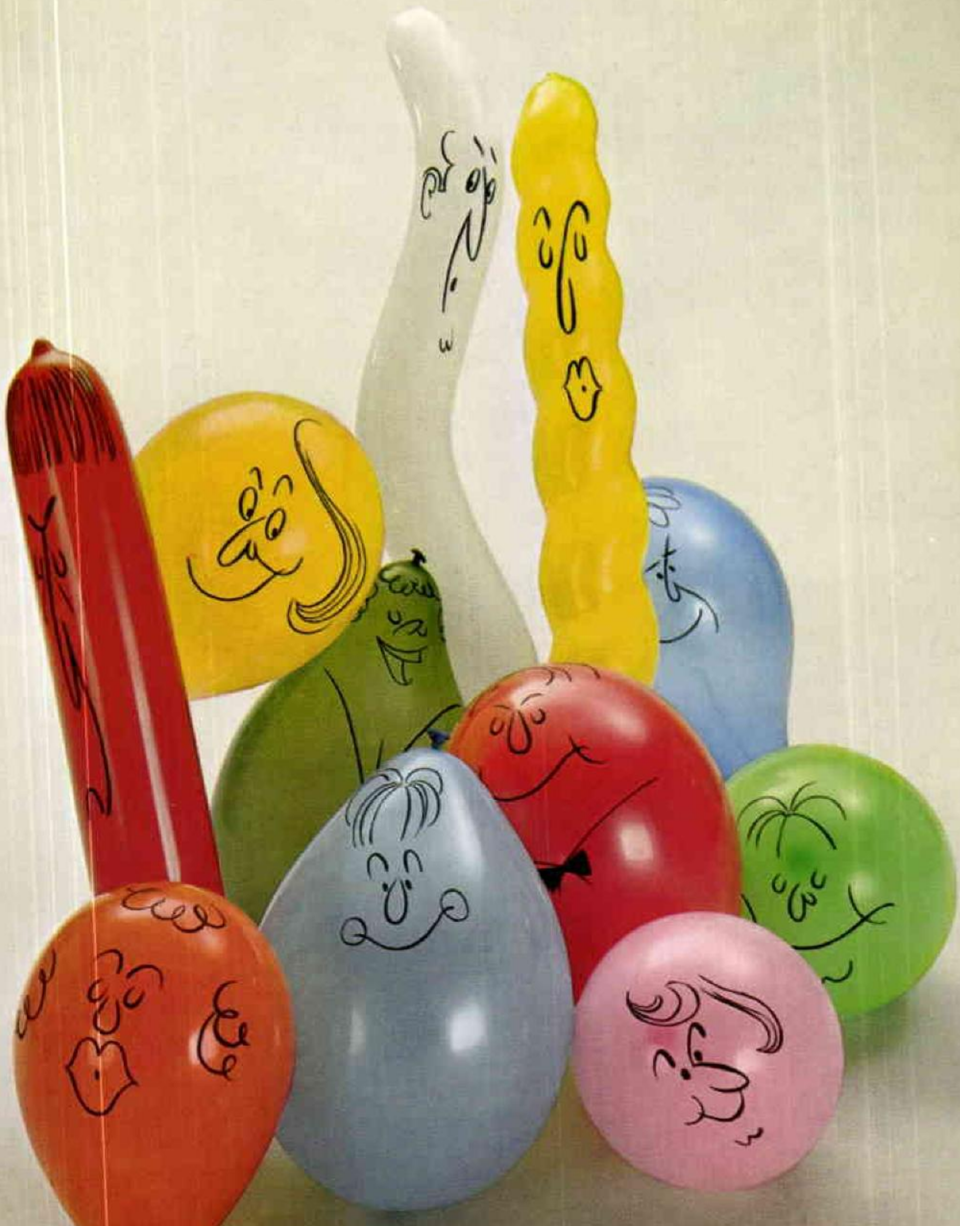
The idea of hip stride control has easily been misinterpreted as a hip lock but was intended to function as a stride length control. The stride length depends on the margin between the distal and anterior stop of the lever and the bumper on the thigh section. We prefer to start a patient with a margin of about ⅛ inch which will result in a short touching step of the beginner. It is easy to remove additional material once a gait pattern has been established and a longer stride length has become desirable.

Our first unit was made for a teenage girl and the temporary leather cover shown in pictures two and three has been replaced with a cosmetic thigh restoration covering the entire thigh section including the closed front knee unit.

This pilot model has now been in use for over nine months and has proven to be functional, durable, and of good cosmesis.







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Date	Region	Place
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April 4, 5, 6	IV	American Hotel, Atlanta
May 2, 3	I	Charter House, Cambridge, Massachusetts
May 3, 4, 5	III	Congress Inn, Williamsburg, Virginia
May 17, 18, 19	V	Heuston Woods State Park, Dayton, Ohio
May 24, 25	II	Americana Hotel, N.Y.C.
May 31, June 2	IX	Newporter Inn, Newport Beach, California
June 14, 15, 16	VII & IX	Wort Motor Hotel, Jackson Hole, Wyoming
June 21, 22, 23	VI	Drake Oakbrook, Chicago
June 22, 23	X	Oak Knoll Hospital, Oak Knoll, California

TRAUTMAN CARVER ATTACHMENTS

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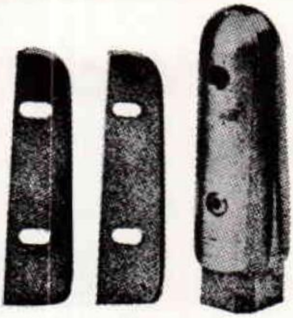

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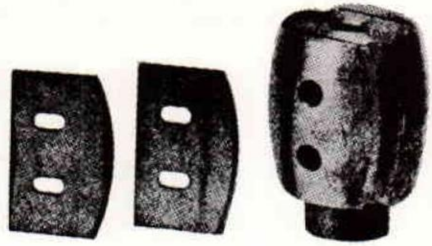
No. 2100AB Blades



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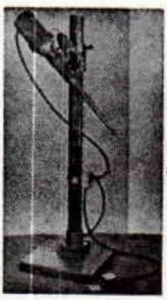

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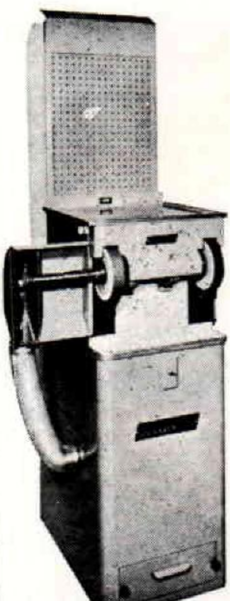

AOPA SHOP MANUALS

The AOPA Shop Manuals which were placed on the market in October, 1967, are now available to both members and non-members of the organization. The two manuals, entitled *Orthotic Shop Manual* and *Prosthetic Shop Manual,* are designed for the use of shops and colleges in training future Orthotists, Prosthetists, and support personnel.

Each manual provides step-by-step instructions for the trainee in basic and advanced fabrication procedures as well as text material covering pertinent tools and materials. Also included in each manual is a glossary of commonly used terms. An instruction guide for the use of the instructor or supervisor will be available in the near future and will be automatically forwarded to all who have purchased manuals.

Every shop owner or manager who has had the difficult task of training much-needed technicians without appropriate training materials and techniques will find the manuals invaluable. They are designed to require a minimum of personal supervision and instruction, and every effort has been made to incorporate the best and most modern techniques.

The manuals are available either individually or in sets. Price has been set at $15.00 per individual manual or $25.00 per set of two.

Based on the excellent response to the manuals, which were displayed for the first time at the Golden Jubilee Assembly, they are well worth the cost. The thirty sets displayed were purchased within a few hours and orders amounting to more than $1,000.00 were taken in one afternoon.

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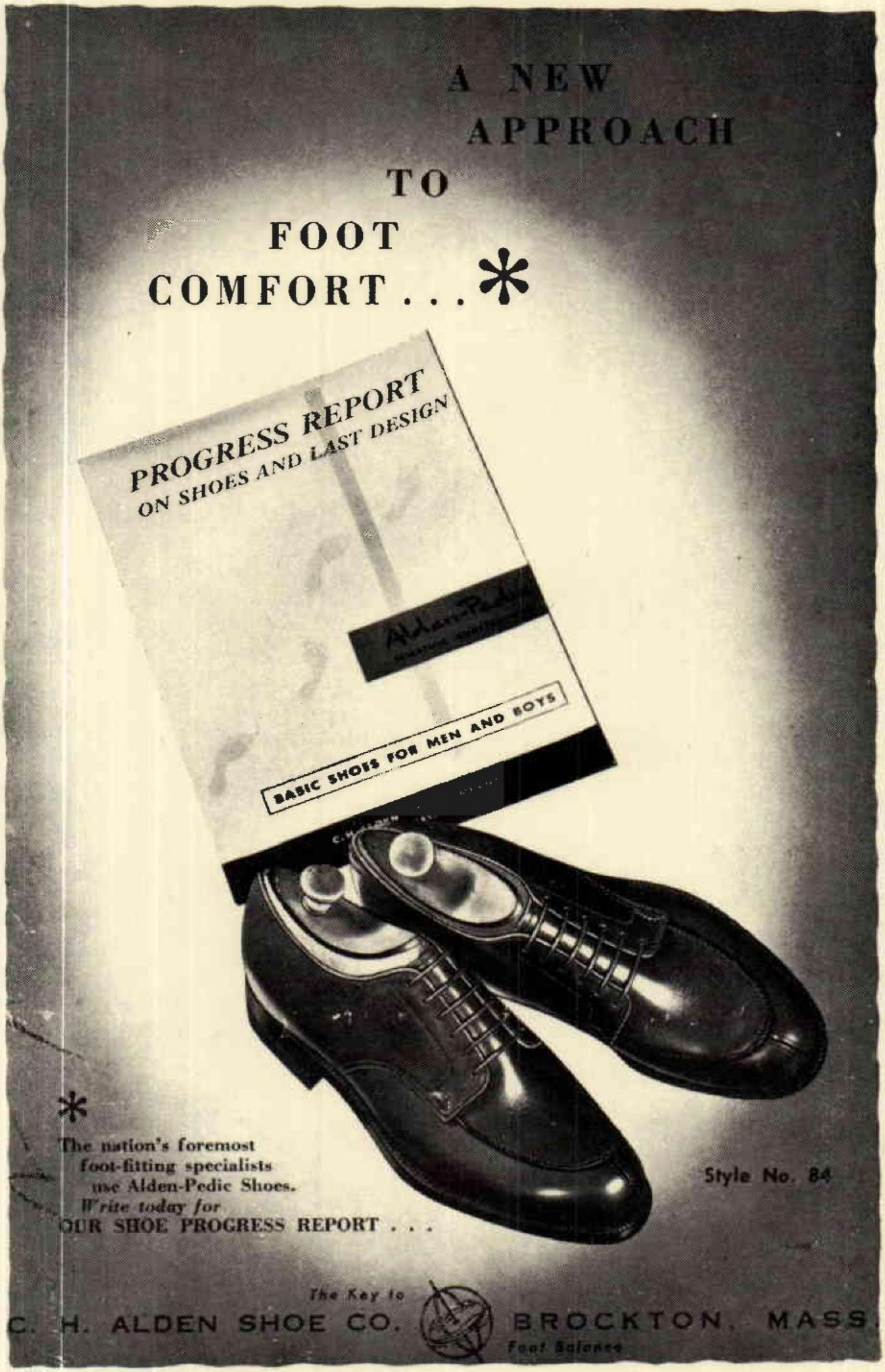
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